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femora yellow, the posterior ones except the extreme base and apex, brown; tibiæ yellow, the hind ones brown; tarsi brown, the first joint and basal half of the second joint of the hind ones, yellow; all femora and the front tibiæ bare, middle and hind tibiæ thinly beset with very short bristles; pulvilli rather large, empodium wanting. Halteres brownish, the apical portion of the knobs white. Length, 8 mm.

Ft. Grant, Arizona. A single specimen collected July 19, 1897, by Mr. H. G. Hubbard, after whom this interesting species is named. Type No. 4071, U. S. Nat. Museum.

LIFE-HISTORY OF THE TWO FORMS OF CERURA NIVEA.

BY RICHARD E. KUNZE, M.D.

In Professor Packard's Monograph on Bombycine Moths, this Cerurin Moth is mentioned as a varietal form of *C. cinerea*. Under date of August 14, 1897, the doctor wrote me, that "there were two pale or white forms of *cinerea* in my region, whose larvæ need to be identified." Professor Packard in his monograph states, that the white color of an example of *C. nivea*, in Mr. Palm's collection, from the Virgin river, southern Utah, is evidently the result of the action of bright sunlight, heat and dryness. The same conditions exist in the Salt River Valley. Phoenix and Yuma hold the record for highest temperature of Arizona, that of the former being 117° Fahrenheit in the shade, while that of Yuma exceeded it by two or three degrees. This information I obtained from U. S. Weather Bureau of this City, and an attaché of the same formerly stationed in Yuma. My examples of *nivea* were all collected at light in Phoenix up to the end of June, a few emerged from collected cocoons, and of those sent six to Mr. Charles Palm for determination. The reply stated, that according to the synopsis of Neumögen and Dyar, they were *Cerura nivea*, variety of *cinerea*. Since my correspondence with Professor Packard, have taken the autumn brood of this insect, from which I bred from ova to pupæ and imagines, and will now give as a result, that this moth has an undisputed right to rank as a species, and not as varietal form of *cinerea*. In its earliest larval stages the resemblance is nearer that of *cinerea* than any other Cerurine, while the last two stages more nearly resemble larvæ of *C. multscripta*. In the East have bred from ova and collected larvæ of any number of *C. cinerea*, *multscripta* and *borealis* and well remember the larval life of those species.

As before mentioned, there are two annual broods in this hot and arid region. The larva feeds on willow and cottonwood and I have collected cocoons early in spring from both food-plants. The examples which served for observation, were two females taken in September, 1897, in Phoenix. One of these was almost immaculate, except a small black spot between the veins of external border of primaries. The other was marked at the base and near cell of primaries with a few black patches and irregular markings. Bodies of both heavily clothed by long white hair, and at first thought I had taken a *Spilosoma*. The base of wings likewise thickly covered by a thick mass of shorter hair than on the body. The males of this species have longer hair than the females. These Arizona cerurines are much larger than the *C. cinerea* of the East. After ovipositing I sent both females, a little the worse for functions performed, to Professor Packard, and also better examples of the spring and autumn broods of both sexes. Ground color of all was snow-white.

The first female secured I placed in a paper box for ovipositing. This example regarding ornamentation, agreed more fully with figure 19 of Packard's Bombycine Moths, described as *C. cinerea* var. *nivea* or Dyar's type of *meridionalis*, ♂. On the night of Sept. 19th a few eggs were laid and some more the following evening. They were laid singly and in piles of 5 to 6 each. They were black, of a dull color, hemispherical and flat at base. Size 1.5 mm. Seven larvæ hatched Sept. 26th and eight more Sept. 27th, between the hours of 8.30 and 9.45 A. M., making time of hatching seven days.

Stage I.—Face neutral pink, pilose, the same as the rest of the body. On all the joints white hairs. Joint 2 has two lateral prothoracic horns finely spinose, of purple color. These processes connected by a dorsal ridge. Two subdorsal, purple stripes from joint 2 to 7, interrupted on joints 8 and 9, and continued from joint 10 to 12. Joint 13 has appended two anal, filamental legs or "tails." Dorsum greenish-yellow in a continuous line to penultimate joint. Dorsum of segments 7, 8 and 9, presents a diamond-shaped mark, due to absence of subdorsal purple stripes. Tails covered with spines or spinules, annulated purple and greenish-yellow. Near insertion the "tails" are purple, and of similar color at middle and terminal parts. Feet yellowish white, almost co. colorous with body. Length of larva without stemapods, 3 mm. and inclusive of these organs, 5.5 mm. The head .5 mm. in breadth, space between head and middle of body .33 mm. breadth, and between joints 6 and 7, .5 mm.

Stage II.—Observed October 3d, larva seven days old. Length of larva without stemapods, 14 mm and inclusive of "tails," 19 mm. Width of joint 2, 2 mm., and of joints 6 and 7, 1.25 mm. Length of prothoracic horns, 1 mm., width of ridge connecting these processes, 3 mm. Face and body sparingly covered with white hair. Face and vertex speckled brown and green. Middle of face and mouth parts green.

Laterally a green stripe passing from vertex to mouth. Prothoracic horns brown, covered with greenish tubercles supporting a black spine. A greenish-yellow dorsal stripe, becoming triangular on joints 2 and 3; it becomes narrow and again widens on joints 6, 7, 8 and 9 into a diamond-shaped patch, constricted on joint 11, and finally widening on joints 12 and 13. A triangular brown patch in the middle of joint 3. A brown spot on joint 6. Joints 7 and 8 ornamented by an oval brownish spot centered green, and surrounded by a circle of minute, greenish tubercles. From the middle of joints 9 to 11, a brownish patch like a maple leaf. Across the penultimate joint a longitudinal brownish dash. Lateral parts of larva green, of the same color as leaf of cottonwood. All legs concolorous with lateral parts. Feet whitish. The green of abdominal parts a lighter tint, and last two joints almost white. Stemapods of a color approaching a purple or lilac brown, annulated with greenish-yellow. The extensive part of our third of "tails" of darker shade. Spinose from insertion to tip.

Stage III.—Noted October 11th, larva 15 days old. Length of larva at rest 24 mm., of body from head to venter, 18 mm. and of stemapods, 8 mm. The width of joint 2, 3.5 mm. of joints 6 and 7, 3 mm. Head subquadrate, 3 mm. in length and 2.5 in breadth. Head brown, face almost oval, brown and of lighter tint at mouth parts. Ground color of face a much lighter brown covered with dark spots. Lateral parts of face tinted brown. Vertex light brown, the same color passing over dorsum joints 1 and 2. A chocolate brown triangular patch on joint 5, widening on segments 6 and 7, and narrowing on joint 8, forming the first, anterior diamond-shaped ornamentation. The same brown dorsal patch is repeated on joints 11 and 12, not quite so large. On joint 13 there is more of an elliptical brown dorsal patch, reaching to venter. A yellow border a little broader than the width of stemapod, passes like an irregular subdorsal line below the brown ornamentation. This line starts at the head and continues uninterruptedly to venter. On joints 3 and 4, this yellow line almost meets with only a trace of brown between. Lateral parts of larva green, exact counterpart of cottonwood leaf, covered by yellowish-white and lilac purple papillæ, some surmounted by hairs. A few dark brown papillæ on dorsal patches. Thoracic and abdominal legs green like lateral parts. Feet of a lighter tint. Stemapods lilac brown near venter, of lighter tint at the "flagellum," and twice annulated yellow, and spinose covered with setæ. Venter and abdominal parts of last three segments whitish. All other abdominal parts of larva concolorous with lateral surface. The spiracles light brown, edged by a tint of green and white centered. Feet quite pilose, hairs fewer in number toward spiracular line.

Stage IV.—Not observed until nearly mature. October 22d, mature larva 26 days old. Length at rest from head to venter, 30 mm., while in motion 37 mm., of stemapods 9 mm. when undisturbed, and during flagellation 10 mm. This gives entire length of 39 mm. at rest.

Length of head 3 mm. and over, width 3 mm. Width of segment 2, 5 mm., of joint 7, 6 mm., of joint 10, 5 mm. Dorsal abdominal diameter of segment 7, 7 mm. Head subquadrate or nearly so, a triangular patch on vertex. Color of head lilac brown with a brown spot each side of vertex. Face of lighter tint, lateral parts yellowish. Antennæ also yellowish. Mouth parts blackish. Dorsal ornamentation of a triangular patch, whitish within and lilac edged, on segments 2 and 3. The median dorsal surface is almost milk white, much as in *C. multiscripta*, thus widely separating

larval differences of *nivea* and *cinerea*. The dorsal ornamentation of larva of *nivea* is bordered by a faint yellow line. Dorsal patch of joints 6, 7, 8 and 9, diamond-shaped, bluish-white on median line, edged rosy lilac when viewed in certain light and bordered yellowish. All diamond shaped patches much constricted near place of union. The patch of segments 10 and 11, also diamond shaped and in coloration like preceding. On segments 4 and 5, the yellowish border of dorsal patch is almost confluent, a trace of lilac tint between it. Joint 12, has a median lilac line which widens on joint 13, to form a smaller diamond patch reaching to venter. This dorsal patch is more lilac on median surface than the other. A brown elevated spot now marks the place of former prothoracic processes. Supra and intraspicular surface light green, spotted and speckled lilac and yellowish over entire parts, as far down as feet. These spots vary from ovoid to hemispherical. Below the yellowish border of dorsal ornamentation of posterior half of body, the green color of larva is lighter tinted, spiracles brown, white-centered. Thoracic feet yellow, laterally spotted brown and sparingly pilose. Abdominal feet pilose, clasping surface white, and just above a brown lunulate mark covered by 6-8 hairs. Abdominal surface concoloring with lateral parts. Dorsal and lateral surface smooth. Stemapods have lost the bright color of previous stage. Spinose, with setæ now very short.

Cocoon.—Color, dark drab. Shape, elliptical, very little flattened, strong, not indented by finger. Size, length, 24 mm ; width across central area, 9 mm.

On the night of October 22d, this larva only 26 days old, commenced to make its cocoon. The only one other example of this brood for five or six days tried hard to transform and failed, so that finally I made an alcoholic specimen of it for Professor Packard.

WHITE FORM OF CERURA NIVEA.

The accumulated evidence referred to under this heading should be accredited to the whitest form of an Arizona cerurine, heretofore known as a variety of *cinerea*. The example from which bred, a female as white as the driven snow, was ornamented with a minute, black spot between each vein on external margin of primaries. The antennæ showed very little black, which was confined to the branches, all elsewhere a spotless white. The insect was secured at light in this city. Confined in a small paper box, I obtained 65 ova, all laid singly, of which about fifty hatched October 8, 1897. In color and size, as well as shape, the ova were black and hemispherical like those of the previous female referred to. Of this brood about 33 reached maturity, and besides reserved two examples of every stage in alcohol for the use of Professor Packard. A full-grown larva or nearly so, by the time it arrived in Providence, R. I., was sent alive, and of which the doctor wrote me, Mr. Joutel made a beautiful figure. Of the earlier stages I

did not take notes, inasmuch as they resembled the progeny of the other cerurine referred to above.

Stage III.—Larva molted October 30th, when 22 days old. Length at rest from head to fork of tails, 14 mm. Stemapods, 8 mm. Breadth of joint 2, 5 mm. joint 7, 4 mm., joint 12, 3 mm. Width of head, 3 mm., length 3.5 mm. Vertex marked by a triangular green yoke, the point of which passes into the median line or dorsal band. Prothoracic horns now quite rudimentary. A round brown spot quite prominent each side of head, 1 mm. in diameter. A few white hairs on face. Mandibles greenish-white and tinted lilac. In centre of face a brown dot, surrounded by an oval, light brown border above mandibles. On each side of this oval two longitudinal lines of same color and length. Above the brown dot a triangular depression lilac edged, which has passing through the middle a whitish longitudinal bar.

On the anterior part of segments 6, 7 and 9, is a small, whitish triangular spot each side of median line, enclosing a purple oval which posteriorly is surrounded by three or four whitish dots. Joint 10, marked by faint dots of same color. Anterior ridge connecting rudiments of former prothoracic horns, of much lighter color than the rest of joint 2. Joint 4 has an elliptical purple patch, and joint 5, one of ovoid pattern on its dorsal surface. The purple of entire dorsal ornamentation bordered by a bright yellow line, which on anterior half of all segments is half a millimeter in width. This yellow line starts from below the insertion of former prothoracic processes, and is lost at the insertion of stemapods. Lateral surface green, dotted and mottled, with yellowish-white and purple spots. A few hairs on lateral surface. Spiracles tinted brown. Thoracic and abdominal legs a brighter green than the lateral parts of larva. Lateral surface of thoracic feet splashed redcish. Clasping surface whitish. Stemapods anteriorly tinted green, and annulated yellow from the middle to the flagellum. Lateral surface green covered by minute, purple papillæ.

Mature Larva, 35 days old, observed November 12, 1897. Length at rest including stemapods, 40 mm., when in motion 50 mm. Length from head to fork of tails, 32 mm., stemapods, 8 mm. Length of head, 3.5 mm., width, 3 mm. Width of joint, 3.6 mm., of joint 7, 7 mm., joint 11, 6 mm. Head purple, vertex green, antennæ white. A yellow spot indicates location of former prothoracic horns. The border of entire dorsal ornamentation is now milk-white from joint 2 to 13. The color of dorsum between this border is greenish white in some places and milk white in others.

The color intermediate between the whiter dorsal surface and whitish border line, has now changed to a lilac tint. Lateral surface of larva spotted and marked purple. Thoracic feet whitish, splashed purplish. Abdominal feet whitish and above clasps purplish. On the abdominal surface of segments, between joint 11 to venter, runs a longitudinal, median purple line. A few white hairs below spiracular line. Spiracles brown with a longitudinal, yellowish dash, ringed greenish-yellow. Anterior part of stemapods concolorous with body, and posterior part of these anal filamental organs is yellow. Entire surface of stemapods studded purple. When prolonged the extensive part of outer third of "tails," bright purple annulated lavender. Under a strong lens the purple spinules covering the stemapods, were seen to support a hair.

Cocoon.—In all thirty-eight cocoons were observed. Of these 37 be-

longed to one brood and 1 to another, all but two larvæ of the last died, affected by a fungus which previously existed in the breeding cage. As soon as larvæ commenced cocooning and had the cells well walled the branches were removed into an envelope box, where the transformation could go on undisturbedly, and permit cocoon to harden. The larvæ gnawed off bits of epidermis from the cotton wood, and mixed with saliva, formed when hardened the silken frame for the wall of its cell. It would continue building on the inside of cocoon until of sufficient strength. On the external surface the cocoon resembled the light gray bark of cottonwood, sometimes of very light tint and again of darker color to agree with surrounding conditions. The dark color of cocoon often corresponded with that of the bark deprived of epidermis. Some were darkest at the terminal ends, of a chestnut tint, especially if spun against the surface of the branch covered by an eschar, always of darker shade. Some cocoons on surface exhibited striæ, such as seen on young branches, here and there speckled, or raised bits of bark to mimicry and deceive enemies. In the open I have observed such cocoons on small canes of willow, as well as on the roughest bark of great cottonwoods, from which they had to be chiseled out with difficulty. All such yielded similar imagines as those bred. The inside of cocoon presented a smooth surface, and a concavity existed in the stem where bark was bitten off to receive one-half or one-third of the pupa. The sides of cocoon generally flattened, plainly showing silken threads, where attached to bark.

The cocoon is elliptical, mostly rounded, a very few flattened, tapering at end like a wedge. One or two cocoons seemed to be more ovoid than elliptical in shape. The measurement of another cocoon taken from a second observation jar is as follows: Length, 33 mm., width, 11 mm.; and height at central area, 6.5 mm. Another smaller cocoon gave length, 25 mm.; width, 9.5 mm.; and height, 5.5 mm.

All larvæ of this brood spun their cocoons between November 8th and 17th.

Pupa.—Cylindrical, tapering mostly at inferior extremity, where much rounded. Toward the head much less reduced in size. The flattened parts of pupa restricted to upper two-fifths, and on abdominal surface extending almost to the end of wing cases. Head and antennæ case prominent, and that of wings much more on dorsal surface. Abdominal segments on dorsal surface thickly covered with fine, dark points, as viewed through a lens. Length, 21 mm., breadth, 7 mm. at the middle part, and 6.5 mm. across thorax. Color of dorsum almost chestnut of lighter tint toward anal segment. A longitudinal, dorsal black line from the thorax to penultimate, abdominal joint. Color of case covering palpi, antennæ and wings, show

traces of a greenish tint as far down as costa of primaries. Abdominal segments a shiny, light brown almost chestnut. Posterior edge of three anterior segments heavily banded by darker brown, which is absent on the last two. A slight depression of the case on either side of thorax, between the wings and first adominal segment.

Of twenty-four imagines emerged, I have the following record : April 14, 1898, one ♂ emerged from only cocoon of the first brood the parent representing the ordinary form of *C. nivea*. The emerged moth agreeing quite in every particular with this form. On same date emerged three ♂ of the second brood, bred from an almost immediate female. The progeny all took after the ordinary form of *nivea* as well as twenty others, which emerged in the following order : April 15th, 2 ♀ ; April 18th, 2 ♂ and 1 ♀ ; April 20th, 1 ♀ and 1 ♂ ; April 21st, 1 ♀ ; April 22d, 2 ♀ and 1 ♂ ; April 23d, 2 ♂ ; April 24th, 2 ♀ ; April 25th, 3 ♂ ; April 26th, 1 ♀ ; May 1st, 1 ♂.

Six cocoons of the second brood I sent to Prof. Packard, and have not heard of result. Several went over to emerge in autumn, provided these do not perish.

Imago.—The pectination of antennæ of the male, black. Entire body heavily clothed with long white hair. Head white, across the occiput a few black hairs ; on the dorsal part of thorax a transverse mark of black hairs, usually fringed posteriorly with yellow hairs. Abdomen white, forewings white, with a few yellow hairs near base of wing. A triangular, black mark across the middle of the cell. A row of black spots between the veins of external border. A similar row of black spots, across the wing near the end of cell. A few minute black spots near base of wing, between cell and inferior border. A few triangular black spots on costa. Hindwings immaculate. Reverse side of wings immaculate. Antennæ of female simple, black. In other respects, the head, thorax, abdomen and wings are ornamented the same as in the male. Legs white, feet blackish in both sexes. Sometimes the intra-venular spots are reproduced on reverse side of wings, and a black spot is noticeable in the cell of inferiors. In the whitest form of *nivea*, black spots occur only between the veins of the forewings close to the fringe of the external border.

Food-plants.—*Populus balsamifera*, var. *candicans*, one of the Western Cottonwoods, and *Salix* spec., a narrow-leaved willow. One larva near Flagstaff, found on *Populus tremuloides*, much resembling species herein described.

Habits.—The young larva feeds on the tender parenchyma of upper side of leaf, thus exposing the skeleton of the blade. It spins a web, to which it clings. When five days old the larva feeds on the green pulp as well as fibrous part of the leaf, except midrib. It was supposed by some that the anal filamental organs or "tails," were for the purpose of aiding in casting aside dung pellets. This is not the case. As stated in a preceding paragraph, I noticed larva less than

three hours old, remove a pellet wedged in tightly between the fork of stemapods, and toss it far away with its mouth parts. In so doing it moved the extensile part of "tails" vigorously up and down. Whenever a larva large or small had to be removed from breeding cage for purposes of noting changes, the stemapods always moved to and fro in a very lively manner. It appears that it might be to frighten enemies. Whenever a larva, while in process of making cocoon, was disturbed, especially before completely housed in it, would endeavor to spin it elsewhere. Even the change from perpendicular of breeding jar to that of horizontal final depository, would cause it to make the attempt. One larva left its cocoon and transformed into pupa in an envelope box.

General Observation.—The first molt of larva occurred in from 7 to $7\frac{1}{2}$ days. Second molt in 15 days. Third molt in 21 days and over. Warm temperature, and moisture seems to facilitate some of the stages. Cool weather much retards the time between stage IV, and pupating. One larva commenced to make its cocoon when only twenty-six days old, and others when from four to five weeks old. After ceasing to feed, the larva rests a day or longer and contracts in size before the last transformation takes place. A week after second molt the color of the dorsal band or diamond patches, changes from chocolate brown to lilac brown, which in certain lights varies from amethystine to purplish tints. Two annual broods occur in Arizona, the pupa of autumn brood hibernating.

PRELIMINARY LIST OF THE DRAGONFLIES OF STATEN ISLAND, WITH NOTES AND DATES OF CAPTURE.

BY WM. T. DAVIS.

There are no large, clear ponds on Staten Island like Echo Lake and Green Pond in northern New Jersey, and consequently the dragonflies that make such bodies of water their home, are not to be found on the Island. The sub-family Libellulinae, however, seems to be well represented and all but two of the species mentioned by Mr. Philip P. Calvert in his Catalogue of the Dragonflies of the Vicinity of Philadelphia, page 267, are here recorded.

Thanks are due to Mr. Calvert for identifying species, or passing upon identifications already made, and at his suggestion I have indicated, by placing an asterisk before their names, the seven dragonflies which are additions to the list of "The Odonata of New York